ISTANBUL TRANSPORTATION MASTER PLAN STUDY TOWARDS MORE INTEGRATED TRANSPORTATION AND MORE SUSTAINABLE CITY

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Abstract: Istanbul, with its strategic location between Asia and Europe and its consequential role for nationwide economy, is an important settlement not only for national but also international activities to some extent. Hence, as transportation is an integral and crucial part of economic activities and a key concept for social, spatial and environmental issues, it was decided to carry out a transportation master plan in 1997 for the term by 2010. The Greater Municipality of the city with its 10 million population set objectives towards a more integrated transport and sustainable city for social, economic and urban development as a whole. Study proved out to be useful to determine long term land use and transport policies and also instruments in order to achieve the targets. The major investment suggested, was the tube tunnel railway system through the Phosphorus with major rail improvements within both sides of the city.

Keywords: Sustainability, Land use management, Integrity, Transportation Planning

1. INTRODUCTION

Istanbul; with its strategic location as a bridge combining Europe and Asia, not only by means of geography but also by culture, has made the city more attractive besides its beautiful scenery and history. Moreover, it is the biggest and the most important settlement for Turkey, as a developing country, since many of the essential national economic transactions start or end in Istanbul. Without doubt, it has also a special place on the international platform since it is the place where Asia and Europe meets through Bosporus Strait. Unfortunately, the city with its today's population of more than 10 millions has been encountering some social, environmental and also economic problems from the consequences of a severe population increase with an average annual rate of 4.3%.

Increasing highway dependent, mainly the automobile transportation together with urban sprawl, has been destructing the nature and landscape of Istanbul, leaving it behind the concept of sustainable urban development. These have been attracting the attentions of not only the politicians but also many experts and researchers, non-governmental organizations and citizens.

The latest comprehensive study of transportation in the city, "Istanbul Transportation Master Plan" (1997, was a collaborative challenge of local authorities and academicians of the spatial and transport planners. It primarily aimed taking strategic transportation decisions that will support environmentally and economic sustainable development of Istanbul. This paper will

first focus on transport related problems due to the lack of effective planning and implementations for keeping pace with the growth and development. Next, the latest challenge for sustainable transport planning will be briefly introduced by its findings.

2. INTRODUCTION OF ISTANBUL TRANSPORTATION MASTER PLAN' 1997

The methodology of the transportation plan was the conventional four-step that is; modeling the trip patterns through trip generation/attraction, trip distribution modal split and traffic assignment. The two software packages, EMME/2 and TRANPLAN were used for calibrating the model and forecasting the future. Finally, the estimations of the model were used as input to the later Cost Benefit Analysis for economic and financial assessment.

Like in Turkey, transportation planning, with its indispensable role for development, becomes rather more severe and crucial when it is subject to developing countries, owing to the instabilities and uncertainties. Although, there have been some criticism against the common transportation planning procedures, especially the four step modeling issues and conventional economic appraisal methodologies, it was a challenge to conduct such a comprehensive transportation master plan study for the following reasons: First, a city-wide survey was conducted and thus ever the latest and largest data of many transportation parameters was collected. Second, it was an integrated and multidisciplinary study of local authorities together with the researchers and experts of the field. Third, it was an attempt to awaken awareness of politicians as decision makers and also the public on the issues of sustainable transport development. Finally, the plan aimed to support the idea of "Enhancement of Social Quality of Life" which is the overall aim of the local authorities in the city.

2.1 The Framework of the Master Plan Study

The main emphasize through out the whole framework has been placed on the concept of "integrity"; the integrity among the authorities to achieve the collaboration, integrity of large scale land use and transport policies to achieve combined and sustainable urban transport policies, integrity of modes to achieve more balanced transportation.

As illustrated in figure 2.1, the objective of the Istanbul transportation plan was to determine a wider framework rather than estimating the future trip demand. Yet this was only the second part of the three-phase study: land use planning; transport modeling; economic valuation.

As for transport modeling phase; first, a household survey with the sampling percent of 0.42% was conducted and necessary data of existing demographics, economics, and transportation system was collected. As the next step, a four step conventional transportation model, consisting of 6,423 transport links and 209 zones, was calibrated. Finally future proposes of land use decisions and transport infrastructure projects were tested by the model.

Following this phase, extensive economic and financial appraisal studies have been and are still being carried out especially in accordance with the government decisions and requires. However, the plan did not only lead to the latter broad economic analysis but also formed a base as guidance to short term and/or small scope transport & traffic management projects.

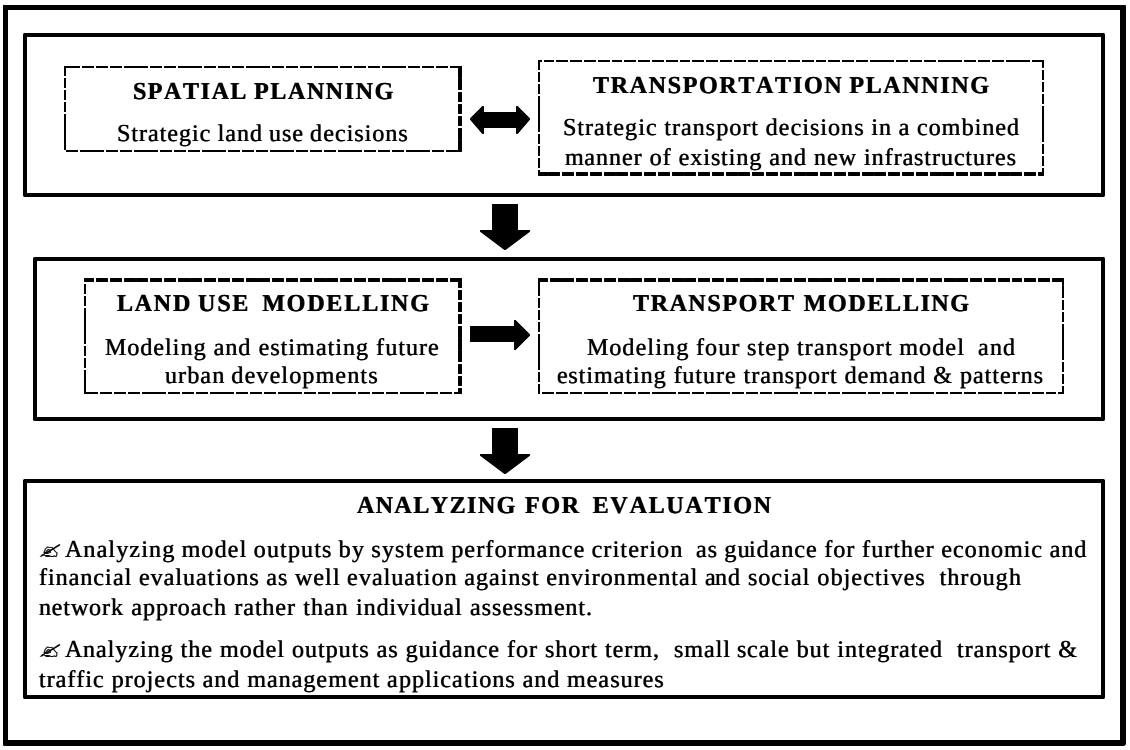

Figure 2.1: General framework of Istanbul transportation master plan

2.2 The Land Use Development Patterns

The issue of land use & transportation interaction has been the crucial concept of urban development and hence transport and spatial planning policies. Yet, as it was for Istanbul, some developing cities lack to establish necessary level of integration between the two during their progress, and therefore they are and will be facing many problems. From this viewpoint, the last two Istanbul transportation master plan studies were the important efforts to combine the two main parts of urban policy, urban planning and transport planning, towards a well planned city and environmentally sustainable transport.

The Department of Spatial Planning of Greater Municipality of the city of Istanbul, proposed land use policies and estimated course of developments accordingly, for the target year of 2010. The major objectives supported by major transport improvements, for a well managed and balanced growth, were summarized below. This was named as "Land use Scenario I" and was source to transport model as input data required for future estimations of trip patterns.

1. Necessary policies will be followed and measures will be taken to control physical growth of the city in order to moderate and maintain a well balanced urban development.

2. In order to support the multi central growth on a linear corridor from east to west, the distribution of new residential areas together with business and commercial centers will be planned accordingly.

3. The urban plans together with necessary measures will be applied in order to restrict the urban sprawl towards the north where it was accepted as the lungs of the city as there is large scale of urban green areas.

4. The distribution of employment and population between east and west sides will be balanced in order to lessen the crossings of Bosporus especially in the peak hours.

In addition to this, the study group also improved another land use scenario as a sensitivity analysis, unless, suggested urban developments be realized and the city keeps on growing undesirably with the current trend. (Land use Scenario II). This was an attempt to prove how different transport decisions accompanied by different land use developments can have different impacts on the environmentally sustainability, economic and social development in the city.

2.3 Transport in Today's Istanbul

There have been 3 transportation master plan studies conducted in 1985, 1987 and 1997 of which the 1997 was the most comprehensive. Here, it may be necessary to give a very brief comparison of the findings of the last two to prove the course of change in 10 years period of time (Table 2.1). The remarkable findings were the rapid increase of population and private car ownership, as they were almost doubled. As expected, the trip rate also increased along with the development of the city; whereas, the average trip time has declined from 53 min. in 1987 to 41 min in 1997. This was concluded by two important reasons, one of which was the decrease in the share of longer trips due to the multi central growth of the city and the other was the major highway network improvements such as the construction of two bridges and motorways, which also contributed to the increase in the share of private car use from 30% to 40 % between 1987 and 1997.

Table 2.1: Comparison of the latest master plan study with the previous

	Master Plan of 1987	**Master Plan of 1997**
Total population of study area	5,760,000	9,057,747
Total employment of study area	2,035,000	2,532,211
Sampling Percentage (%)	0.16	0.42
Study Area (Ha)	86,962	154,733
Private Car Ownership (/1000)	52	98
Motorized Trip Rate	0.87	1.00
Average Trip Time (min)	53	41
Modal Split	30% private / 70% public	40% private / 60% public

The distinct and appealing characteristic of the city comes from its layout between the two continents with the Bosporus in the middle, which is also the reason to some transportation and traffic problems at the same time. The first Bosporus cross as a highway bridge was constructed in 1973, together with the necessary beltway as an outer motorway simultaneously. The second bridge again as a highway bridge started to operate in 1988 on the north side of the first bridge, connecting to the Trans European Motorway (TEM). Though the

TEM serves for inter city transportation, it is completely being used for the daily intra city trips crossing the Bosporus especially in the rush hours.

The increasing number of trips between the two sides is also due to the unbalanced distribution of population and employment among east and west of the city, such that the 65% percentage of total population lives in the European side where 73 % of the total employment opportunities exist. Through the O/D matrix, derived from the household surveys as given in table 2.2, it was found that 11% of the total daily trips, 1,081,228 trips/day, are being made between two continents. This causes the overloads and severe delays on the inner-city motorways together with the Bosporus. The results of the peak hour traffic assignments for 1997 also proved that not only the bridges but many other roads are overloaded. Around 5.0% of the total highway network has volume/capacity ratio over 1.0 and similarly the ratio is close to 1.0 for many others, especially the main trunk roads.

Table 2.2: The O/D trip matrix of Asian and European sides of Istanbul (1997)

	Europe		**Asia**			**Total**
	Peak	**Daily**	**Peak**	**Daily**	**Peak**	**Daily**
Europe	578,222	5,782,220	16,588	540,614	594,810	***6,322,834***
Asia	91,538	540,614	241,300	2,412,998	332,838	***2,953,612***
Total	***669,760***	***6,322,834***	***257,888***	***2,953,612***	***927,648***	***9,276,446***

The public transportation network in the city is composed of bus and minibus routes for highway transportation; LRT, Tramway, Commuter rail and metro for railway transportation; ferries for inland water transportation. The buses and minibuses together dominate the public transportation since the share of buses and minibuses are 56.9% and 32.7% respectively. The ratio of rail and inland sea is quite poor where the total figure for railways is 6 % and 4.4 % for ferries for passing the Bosporus.

The whole bus network is 1,250 km. with 460 bus lines and 4,000 buses being operated through 6,100 km length of total lines serving for 2,500,000 passengers a day in 1997. Minibuses also have a great deal of contribution to the city transport and the total ridership is around 1,500,000 per day.

The main longest rail line is on the south of the city along the coastal area of the Marmara Sea with the length of 27.6 km in the European side and 44.2 in the Asian side (please refer to figure 4.3). The system is rather old and low capacity; such that it is being operated with the headway of 10 min and average speed of 20 km /hr and carrying a daily volume of 176,000 passengers. LRT and Street Trams with the total length of 18.6 km together serve for 257,000 passengers per day. All the rail systems when adding the first metro section (7.1 km), opened in 2000, the total length of railways in the city makes 97.5 km. which is far behind than it should be.

The city transport is mainly under the responsibility of the local authorities: all urban rail systems, 70 percent of all bus lines and ferries are publicly owned and operated. Only 30% of the buses and the minibuses are privately owned but still with some control of the local

authorities in terms of route vehicle and fare regulations. Besides, the two toll bridges are under the control Highway Department and are generating large amount of revenues.

3. COMPARISON OF ISTANBUL WITH THREE METROPOLISES

Relevant to this paper, it was found to be useful to compare Istanbul with some other metropolises in developed countries; since Istanbul is in the long term aiming at reaching the infrastructure level which have already been realized in these metropolises. Also comparison will be proving the necessary and important facts that the city is lacking and should be included in its future transport policies as proposed in the master plan. As given in table 3.1, Greater London, Il de Paris, Tokyo Prefecture was chosen to set side by side for comparison and better representation. Here they are the areas defined as Greater London, Il de Paris, Tokyo Prefecture and Istanbul metropolitan area due to the restrictions of data.

The GDP per capita in Istanbul, $ 4,416 is rather small when compared to the other three. Contrary to GDP, total population, urban density is quite similar in Istanbul. However, mobility is smaller in accordance with the development stage, where the trip rate for all trips is 1.54 and for total motorized trips is 1.00. The average trip length, 18.6 km, is the highest for Istanbul followed by that of Tokyo Prefecture, 10.70 km and also is more that the twice of the other two. Additionally, the average speed of all types of vehicles, 26 km/hr is the lowest for Istanbul and Tokyo Prefecture. Therefore, the total time wasted is quantitatively higher thus the level of service of highway transport supply is the worst for Istanbul.

The car ownership rate 113 private cars per 1,000 inhabitants, was rather low compared to many other European cities. Still, parallel to the development, it is being expected to increase more rapidly by the end of the planning term, 2010. The share of private transportation is the most modest in Istanbul with its model split for total private and public transport, 26% and 39% respectively. However, the percentage of private transport is expected to increase with the increasing car ownership rate as it was before, and the increase may be much rapid unless necessary improvements of public transport network are not fulfilled.

Comparing the total length of roads per 1,000 inhabitants, it was found that the figure, 555 m for Istanbul is approximately 1/4 of 1,926 m for Il de Paris, 1,919 for Greater London, 4,014 for Tokyo. Unfortunately, the case for the urban rail network is the worst, as the total length of 9.75 m of urban railways per 1,000 inhabitants is quite a small figure besides 166.41 147.06 and 91.89 for Greater London, Il de Paris and Tokyo Prefecture respectively. Since the urban rail network is poor, buses and minibuses together constitute the main body of the public transportation in the city as explained. The average annual bus and minibus boarding per inhabitant, 206 is the leading figure followed by Greater London, 172 boarding per year.

To summarize, it can be concluded that the current transportation network is not environmentally friendly and the level of transportation provision especially rail network is far behind the developed cities though Istanbul is home to similar population and urban densities.

Table 3.1: Comparison of Istanbul with Greater London, Il de Paris and Tokyo Prefecture with the data collected from Millennium Data Base for the other cities

	Istanbul	Greater London	Il de Paris	Tokyo Prefecture
Total population (x1000)	9,500	7,000	11,000	11,000
GDP per capita ($)	4,416	22,362	41,304	45,425
Urban density (persons/ha)	59.60	59.07	47.62	87.68
Job density (employment/ha)	16.40	31.50	21.31	47.53
Passenger car Ownership (1000 persons)	113	332	418	307
Trip Rates (trips/day/person)	1.54	2.81	2.83	2.86
Average trip length (km)	18.60	8.50	6.90	10.80
Share of motorized public within all trips (%)	39	16	17	31
Share of motorized private within all trips %)	26	49	44	32
Share of trips by foot within all trips (%)	35	35	39	37
Paved roads per 1000 inhabitants (m)	555	1,919	1,926	4,014
Rail network per 1000 inhabitants (m)	9.75	166.41	147.06	91.89
Average speed of all highway vehicles (km/hr)	26	29	36	26
Annual bus and minibus boarding per inhabitant	206	172	90	59
Annual urban rail boarding per inhabitant	14	209	169	553
Total annual vehicular emissions per area (kg/ha)*	200	4,573	1,214	404

**Total Vehicular Emissions represents CO, NO_x, SO2, and VHC*

4. THE FUTURE OF THE TRANSPORT IN ISTANBUL

The future transport policy objectives for planning term by the end of 2010 was set by the study group and published in the first chapter of the plan as fallows:

1. To determine the most efficient transport network in accordance with the proposed land use decisions, emphasizing the priorities compatible with the growth patterns and sequences.

2. To decide on the major transport infrastructures to increase the accessibility to support projected economic growth

3. To develop transport policies that will lead to more environmentally sustainability

4. To emphasize the lack of rail system and shape the high capacity rail network of the city especially linking to rail tube Bosporus crossing

5. To emphasize the issues where further smaller scale and short term transport and traffic policy and measures should be taken.

As mentioned earlier two different land use developments have been proposed, however within the limited space of this paper, only the results of the first land use scenario, as proposed by the local government, will be given (Land use Scenario I)

4.1 Estimation of Urban Development for Istanbul by 2010

The car ownership is expected to increase to 225 by the end of the 2010 rather rapidly, different than that of Tokyo and London. Because they have already reached their saturation; whereas Istanbul is still experiencing a severe increase period as shown in figure 4.1. The population is assumed to reach to 15,400,000 with an increase rate of 70% and the employment to 6,000,000 by the rate of 130 % within the next 13 years.

The existing business districts are lying along the Bosporus on the European side and on the south west edge by the Marmara Sea for the Asian side. But the local Spatial Planning Department projects a linear growth on the east and west of the city as seen in figure 4.2. The proposed development of new commercial, industrial and residential areas, of which the construction of some have already started or completed, all match with the proposed land use plans. Besides, the distribution of population and employment among the two sides is aimed to be rather balanced in order to reduce the work trips for moderating the increase of loads on two bridges. It was proposed that 66% of population and 67% of employment will be locating in the European by the end of the planning term.

Throughout a detailed study of the demographics, economic development and vehicle ownership; it was estimated that the trip rate for motorized trips will also increase by 10% and reach to1.1 trips/person. Such a higher mobility and population will be producing a total number of 16.7 million daily motorized trips in 2010 which means a huge increase by 85% when compared to the 9 million trips in 1997. Therefore, the necessity of high capacity public transport systems is of high importance and will be playing an important role in environmentally sustainable future of the city.

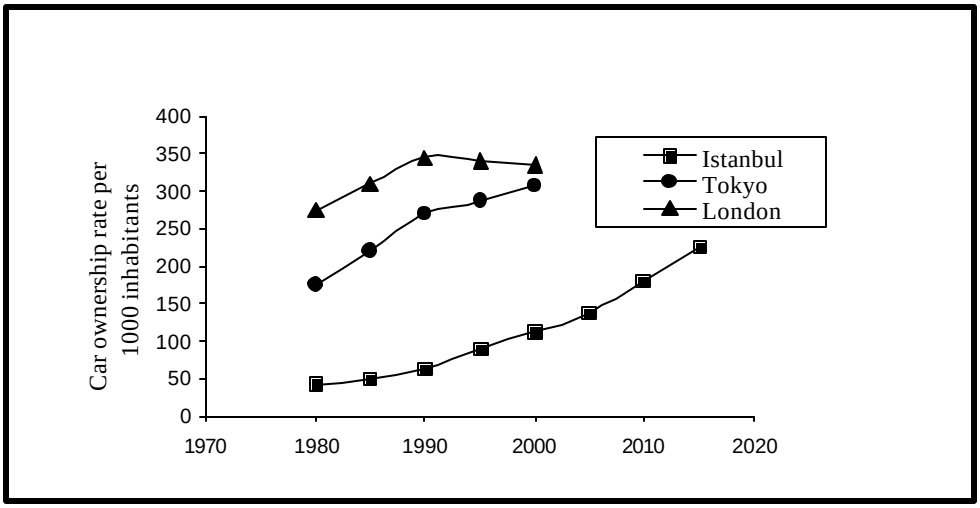

Figure 4. 1: The of car ownership rate in Istanbul, Tokyo and London

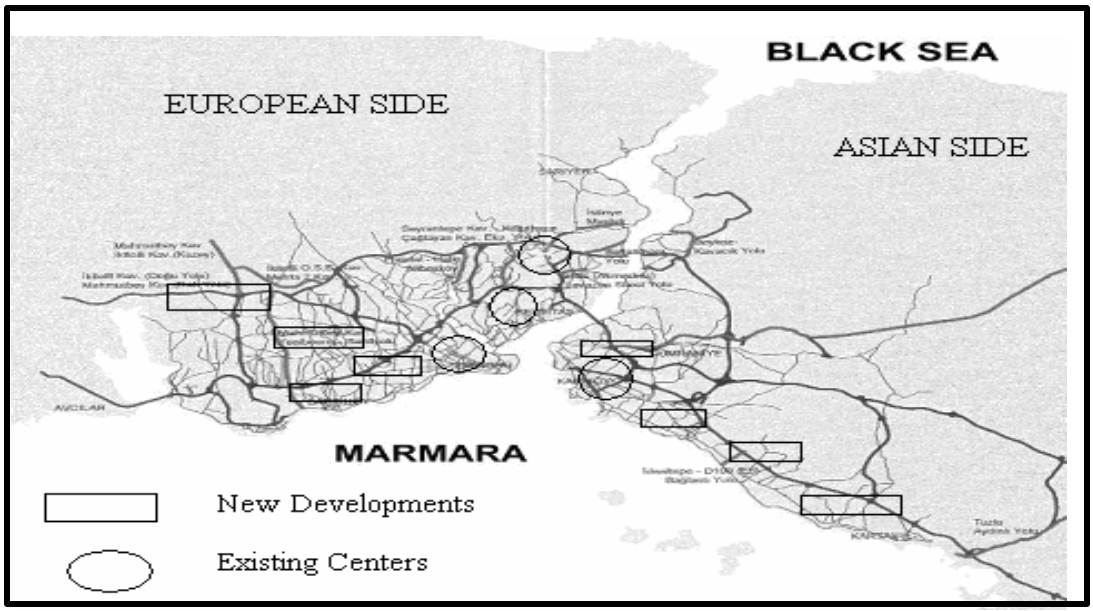

Figure 4.2: Current and proposed urban development patterns

4.2 The Transport Network Alternatives for the Target Year 2010

There have been 9 different future transportation network alternatives developed within the study. However, here only the three, with special emphasize on the third Bosporus crossing, will be summarized (table 4.1). The largest railway network, presumed by the Alternative IV, is illustrated in the figure 4.3. In this alternative, including revision of the existing rail systems, the total length of new rail constructions becomes 289.4 km. All the three alternatives include the rearrangement of the bus and minibus routes and to serve as feeding routes for the proposed rail systems.

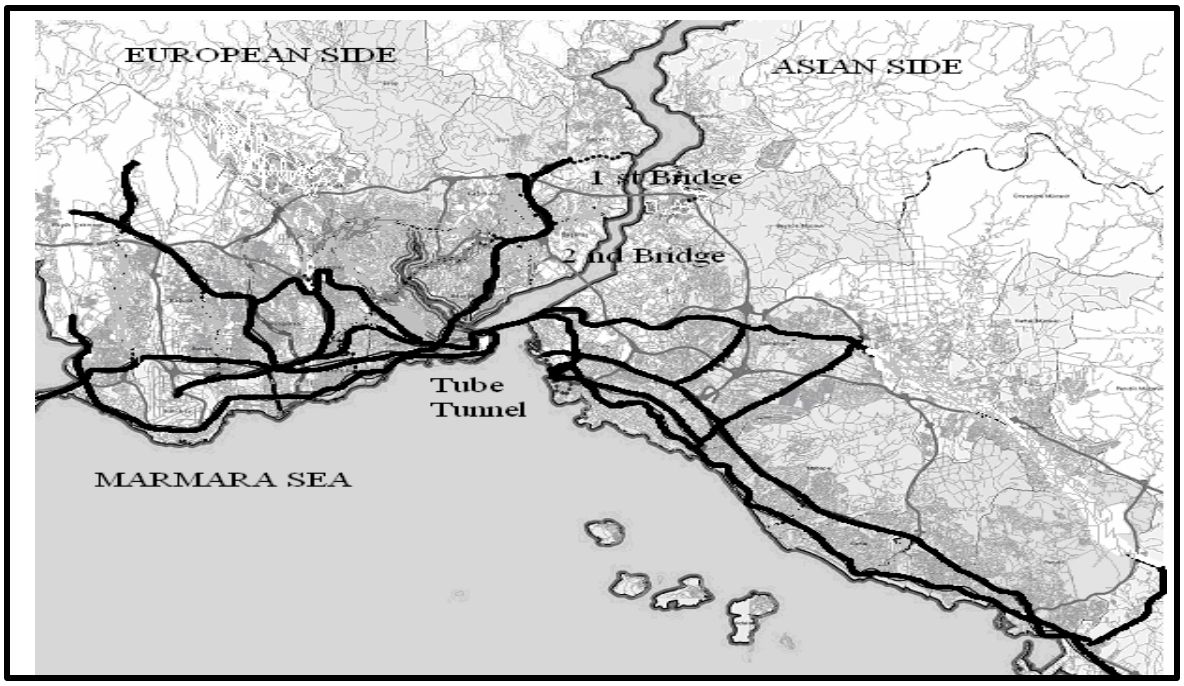

Figure 4.3: The very largest railway network proposed for 2010

Table 4.1: Future transport network alternatives proposed by the master plan study

Alternative III **Improved rail network in each side supported by the improved ferry Bosporus crossing Scenario**	1. New rail lines within each side without Bosporus crossing, total length of rail network adds up to 213 km 2. 45 km new highway improvements together with the necessary expansion for capacity improvements 3. Additional 11 inland water lines for Bosporus crossing
Alternative IV **Improved rail network of Alt. III with rail tube Bosporus crossing Scenario**	1. New rail lines of Alt III with the tube rail Bosporus crossing connecting the 71,8 km existing commuter rail which will be increased to the metro capacity, total length of rail network adds up to 226 km 2. 45 km new highway improvements together with the necessary expansion for capacity improvements 3. Additional 3 inland water lines for Bosporus crossing
Alternative IX **Improved rail network of Alt IV with the third highway and rail bridge Bosporus crossing Scenario**	1. Widest rail network reached by adding more lines to that of Alt IV including third bridge rail system, total length of rail network adds up to 270 km 2. 113 km new highway improvements including the third bridge highway crossing with its beltways together with the necessary expansion for capacity improvements 3. Additional 3 inland water lines for Bosporus crossing

4.4 Results of the 2010 Forecasts by the Transport Model of the Master Plan Study

There were two separate assignments within the limitation of 4 step modeling; highway assignment and public transport assignment. Some outputs of both assignment models with further results for the Bosporus crossings were summarized in the below table 4.2. The highway network was loaded with the equilibrium assignment by using the generalized cost as the unit, where the average value was calculated for Istanbul as 3.57 $/hour/person. The public network was assigned by all or nothing algorithm based on the generalized cost as the combination of transport fees and the value of time, of the users.

It was estimated that the share of rail mode within the total public transportation will increase to 45.5% from today's 6%, in case Bosporus tube tunnel connects necessary rail networks on both sides of the city. The Third Highway Bridge with its LRT line in the middle increases the rail share to 56.7%; but on the other hand, it causes a 82.4% of rise in pcu-km. In case that The Third Highway Bridge was not constructed, the total pcu-km was also found to be increasing substantially, by %70. The total numbers of Bosporus crossings for 2010; 1.5 million is the smallest if no additional infrastructure is provided through the Bosporus. Not surprisingly it becomes 1.8 million for tube tunnel scenario inducing the trips between two sides. This can be concluded that the tube rail will be meeting the existing demand by providing high capacity with less environmental load and less time loss costs.

In table 4.2, when referred to the changes relative to 1997, it is obvious that a substantial amount of urban transport changes are being expected. Therefore both local and central governments are at a very important point to manage the dynamics for the benefit of the city, while taking land use and transport decisions for sustainable urban development.

Table 4.2: Assessment of 2010 future alternatives against some performance parameters

PERFORMANCE PARAMETERS	ALT. III	ALT. IV	ALT. IX
Pcu-km	44,154,510	44,477,100	47,269,910
Change relative to 1997	+70.4%	+71.7%	+82.4%
Bus+minibus share over all public transport	55.6%	53.5%	42.8%
Change relative to 1997	-61.9%	-68.2%	-110.3%
Rail share over all public transport	41.5%	45.5%	56.7%
Change relative to 1997	+591.7%	+658.3%	+845.0%
Ferry share over all public transport	2.9%	1.0%	0.5%
Change relative to 1997	-27.5%	-75.0%	-85.0%
Total trips crossing Bosporus	1,500,000	1,800,000	2,400,000
Bosporus trips over all trips	9.1%	10.7%	14.2%
Pcu passing Bosporus (Percentage over all)	39.6%	38.0%	38.4%
Bus+ferry trips passing Bosporus (Percentage over all)	60.4%	27.8%	18.4%
Rail trips passing Bosporus (Percentage over all)	-	34.2%*	43.2%**

**Rail system tube tunnel* ***Rail system tube tunnel + 3rd highway bridge LRT system*

4.4 Further Remarks on the Model Outputs

Bosporus Crossings

The third Bosporus crossing has been the crucial for the city transport, despite the fact that only 10% of all movements are made between the two the sides. It proved problematic for the government whereas it was also very attractive to both national and foreign investors with its huge investment budget. The railway tube tunnel with the total length of 13.6 of which 2 km is underground driven tunnel was estimated to be 850 million US dollars. The total cost becomes 25 Billion US dollars when adding the cost of upgrading to metro capacity the 63 km commuter rail existing within each side, connected by the tube tunnel. The Third Highway Bridge was projected as 3 lanes in each direction with the LRT line running in the middle. The total cost of the bridge, together with the necessary links that connects the bridge to the network, was estimated as 1.5 Billion US dollars.

As mentioned above, not surprisingly the Third Highway Bridge will stimulate the car use, which was not something new for Istanbul. The city did experience the paradox of bridges and also is doing now for the third, meaning that every new bridge is reaching to its capacity much earlier than expected and creating the demand for the next.

Passenger Car Trips

The results of highway assignment also showed that the average highway speed for passenger cars in the peak hour will be decreasing from 26 km/hr in 1997, to around 21 km/hr in 2010 independent of Bosporus crossing decisions. The increase in total km traveled and decrease in the average speed can easily be concluded by anybody that; much worse traffic conditions with more severe delays for the highway users in the near future than today. The increasing, car ownership and mobility, which can not be avoided through economic development, are the two main reasons yielding these two undesired results. Therefore, any policies and measures for controlling the rise on the demand side and increasing the efficiency and the capacity of the road network within both sides on the supply side are of high importance for Istanbul.

Spatial Urban Developments

Thanks to the managed and balanced urban dynamics and land use development projections for 2010 by of the Department of Spatial Planning, the average trip length for 2010, 17 km was found to be similar even lower than the value for 1997, 18.6 km. This is the proof of controlled growth, against the urban sprawl, as presumed by the local authorities. In reverse case, such that the local government can not fulfill its land use decisions and the city keeps on growing with the current trend (Land use Scenario II), it was found that the average trip length will be increasing to around 20 km, bringing more traffic loads with higher pcu-km. together with higher congestion costs and environmental loads.

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Accessibility of Public Transport

Since now, the skeleton of the public transport network was formed by a wide network of buses and minibuses. The average speed for buses and minibuses in the morning peak hour is around 24 km/hr but it is expected to decrease to 18 km/hr or even lower by 2010. Considering out of vehicle bus waiting time due to low punctuality in the rush hours, the

accessibility of public transport will be far from it should be for the city, unless an efficient rail network is realized.

However, the proposed rail network consisting of metro system with an average speed of 40km/hr, LRT with an average speed of 35 km/hr and some short street tram lines of 20 km/hr speed will no doubt substantially increase the accessibility of the public transport. If such an integrated and balanced composition of public transport, favoring the railways, can not be established, the city will need more buses and minibuses which will bring extra more loads of congestion and environment. Also in many corridors the demand will not be able to be met by the buses even with bus prior lanes, since they are not the solution for mass transport in metropolitan cities.

5. CONCLUDING REMARKS

1. Currently, the main emphasize of urban development issues is on "Quality of Life" and "Social Equity" through economic and environmentally sustainable development. Social quality and satisfaction is the function of many parameters of spatial planning, transportation planning and economics. This is quite difficult task as so many conflicting and competing one side and also many complementing and supplementing interests, policies, actors are involved. That is why a package approach or namely integrated approach is needed to reach an optimum solution for enhanced quality of life.

   The master plan has done well with the efforts of integrating its transportation and land use plans at strategic level and in long term. However, the study was highly strategic and projects oriented. It may be necessary to include some integrated urban transport policies such as pricing policies, yet such integrated measures may yield successful outcomes both in short and long term.

2. Economic efficiency and financial deficiency are not the problems specific to developing but also to the developed counties. However as obvious, the circumstances are more severe and complicated for developing world with their unstable economies. Besides, most of their infrastructure investments dependent on foreign aids and barrowing. Therefore economic and financial evaluations with larger framework are of high importance.

   One of the best uses of transportation master plan is that it made available a network Cost Benefit Analysis, rather than one project oriented. Like many other similar countries, the availability and provision of financial resources is the crucial matter which needs to be assessed in some more depth in Istanbul. There should be further studies for the creation and transfer of some national funds through revising taxation policies, public private partnership. In such sense, some of the financial barriers may be overcome and losers may be compensated by the money coming from the groups who benefit.

3. Environmental sustainability is of high rank both locally and globally. Developed countries are much more aware and have more policy implementations compared to developing. Economic and industrial development by no means has undesired and

inevitable impacts on the environment and many studies are still being carried out to establish the balanced economic and environmental development.

From this point of view, master plan mainly focused on the rail systems and proved that the construction of the third bridge will bring extra environmental loads. However, the problem is wider and should be examined by the perspective of the experiences of large developed cities in order to take measures before the problem occurs. The most well known policies must also be applied such as: the supporting the purchase of the green vehicles and levying green taxes on fuel consumption, where the car ownership has not reached to its saturation and will be increasing faster in the near future.

4. The economic growth or increase in the total GDP per capita has some important results linking to the trip behaviors. Increasing income will cause a shift in the life aspirations towards higher preferences with more consumption hence more mobility. The higher value the people put on their time savings, the higher speed and accessibility they demand. This was also proved by the master plan study through the estimated higher trip rate. At this point the local and central government should provide the city with higher accessibility through land use and transport policies in order to support the targeted economic development.

6. CONCLUSIONS

Istanbul transportation master plan, not only specific to Istanbul but also for other similar cities, was a proof that they are at the edge of rapid growth and development. Therefore, seeing the future from a wide point of view and setting transport policy and objectives accordingly is a must for economic and environmental sustainable development. By paying attention to the experiences of already developed countries, taking necessary measures to tackle with substantial future changes, as early as possible will be benefit of such cities. It is believed by the authors that evaluation and moreover comparison of case studies like Istanbul case, will be increasing the know how. Especially the disseminate of knowledge and experiences within both developed and developing countries will surely be exerting a positive influence for sustainable urban development.

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REFERENCES

May, A.D. and Roberts, M (1995) The design of integrated transport studies, **Transport Policy, Volume 2,** 97-105.

Still, B., May, A.D. and Bristow, A. L. (1999) The assessment of transport impacts on land use: practical uses in strategic planning, **Transport Policy, Volume 6,** 83-98.

May, A.D., Shepherd, S.D. and Timms, P.M. (2000) Optimal transport strategies for European cities, **Transportation, Volume 27,** 285-315.

Hayashi, Y. and Morisugi, H. (2000) International comparison of background concept and methodology of transportation project appraisal, **Transport Policy, Volume 7**, 73-88.

Timms, P.M., May, A.D. and Shepherd, S.D. (2002) The Sensitivity of Optimal Transport Strategies to Specification of Objectives, **Transportation Research A, Volume 36,** 383-401.

Hayashi, Y., Suparat, R., Mackett, R., Doi, K.D., Tomita, Y., Nakazawa, N., Kato, H. and Anurak, K. (1994) Urbanization, motorization and the environments nexus - An international comparative study of London, Tokyo, Nagoya and Bangkok, **Memories of the School of Engineering, Nagoya University, Volume, 46,** Nagoya, Japan.

Greater Municipality of City of Istanbul, Transportation Department of Technical University of Istanbul (1996) Istanbul transportation master plan, **Calibration Report,** Istanbul, Turkey.

Greater Municipality of City of Istanbul, Transportation Department of Technical University of Istanbul (1997) Istanbul transportation master plan, **Final Report,** Istanbul, Turkey.

The millennium cities data base for sustainable transport (2000) Analysis and recommendations, International Association of Public Transport, Belgium.